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Nature's fireworks: cosmic showers detected in the SπRIT Time Projection Chamber

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The newly constructed SπRIT Time Projection Chamber (TPC) [1] has been used in a series of experiments at RIBF in RIKEN, Japan. This detector utilizes a 12,096 channel pad plane to reconstruct 3D images of events that occur inside a detection region. This makes the detector very useful to study nuclear reactions. The main goal of this device is to place constraints on the nuclear symmetry energy at supra-saturation densities. To calibrate the TPC, cosmic rays were studied. Cosmic rays are high energy particles produced in the galaxy. The flux of cosmic rays consists mostly of protons, but also contains heavier nuclei, with abundances of nuclei decreasing with increasing mass. These cosmic rays interact with the atmosphere so that much of the energy of cosmic rays that reaches the Earth's surface are in the form of leptons such as muons and electrons and their anti-particles. The interaction of a cosmic ray with the atmosphere or solid materials at the surface of the Earth, such as the SπRIT TPC, can produce a cosmic ray shower, consisting of many fast charged particles. These charged particles will have curved trajectories in the magnetic field of the TPC, with lighter particles sometimes producing a spiral. The images of these shower events collected on the 2D readout plane of the SπRIT TPC results in images like "fireworks from above". These events, along with their interpretations, are shown on a website designed to showcase such events: https://groups.nscl.msu.edu/hira/cosmic/. This website will be used as an outreach tool, with activities to engage a K-12 audience. Possible activities highlighting these cosmic ray events include exploring principles of particle detection, principles of particle identification, principles of cosmic rays, and how cosmic rays can be used to demonstrate relativity. This work is supported by the U.S. Department of Energy under Grant Nos. DE-SC0004835 and National Science Foundation Grant No. PHY-1565546.

[1] R. Shane et al., "SπRIT: A time-projection chamber for symmetry-energy studies," Nucl. Inst. Meth. A, vol. 784, p. 513-517, 2015. http://www.sciencedirect.com/science/article/pii/S0168900215000534

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